DRAFT
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Groundwater Substitution Transfers

How to Make Them Work in the Sacramento Valley in 2002

I. Introduction

The purpose of this and related papers is to provide technical guidance to local parties who wish to sell water to the State's 2002 Dry Year Water Purchase Program or the Environmental Water Account (EWA) [1] through water transfers. The focus of these papers is water transfers from areas in the greater Sacramento Valley to areas south and west of the Sacramento-San Joaquin River Delta. These papers should not be considered to provide technical guidance for other water source areas. The information in this paper is intended to assist parties in developing the data and materials needed to support agreements for water transfer purchases and water conveyance with the Department of Water Resources (DWR) [2].

This paper was assembled by the Water Transfer Office of DWR. Contributions to this paper were made by technical experts from within DWR and U.S. Bureau of Reclamation (USBR) and interested parties in the Sacramento Valley. DWR appreciates the assistance of all the individuals who helped produce and review this paper. Those who helped may not agree with all aspects of this paper. However, most agreed that its development would be helpful as DWR begins water supply purchase discussions for the State's 2002 Dry Year Water Purchase Program and EWA.

For an overview of water transfers for 2002, parties are encouraged to read a companion paper, "Information to Parties Interested in Making Water Available to the Environmental Water Account (EWA) or State's 2002 Dry Year Water Purchase Program." This paper is available by contacting the Water Transfers Office at (916) 651-7054.

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[1] The Environmental Water Account (EWA) is a State and federal program established in the August 2000 CALFED Record of Decision to allow additional environmental protection actions with no uncompensated water or power costs to the water users. The water supply costs of the program are made up in part through water transfers.

[2] These papers are presented to help facilitate and expedite the contracting process with DWR for responsible water transfers and are not intended to have regulatory effect.

DWR supports water transfers as a way to help meet local water supply needs as well as those of the State and its environment. The purpose of this document is to provide guidance to local parties who seek DWR assistance for a water transfer involving the substitution of groundwater in lieu of surface water diversions in the Sacramento Valley. Groundwater substitution transfers are the additional pumping of groundwater with a one-for-one reduction in surface water diversions that would have occurred absent the additional groundwater pumping. The amount of reduced surface water diversions is then transferred to other water users.

California law protects the surface water rights of water users who engage in groundwater substitution transfers. Also, overlying users of groundwater, including those with access to surface water, do not lose the right to use their underlying groundwater supplies for reasonable and beneficial use simply because they have access to surface water.

California law protects other existing water users, the environment and (in many cases) the source area economy when water is transferred[3]. Groundwater substitution transfers have the potential to cause injury to other local groundwater users due to the additional groundwater pumping needed to allow the surface water transfer to take place. Injury can also occur to downstream water users due to interaction between the surface and subsurface components of the water system if all or a portion of the additional pumped groundwater reduces stream flows at a time when it is used by downstream users.

The rationale behind a groundwater substitution transfer is that surface water demands are reduced because a like amount of water from an alternative source, in this case groundwater, is used to meet these demands. The unused surface water is then transferred to other users. Typically, the amount of water credit given such a transfer is the amount of the increased pumping that takes place to support the transfer. This credit assumes there is no

[3] California Water Code Section 1810 *et seq.,* specifies the requirements that must be met in order for DWR and other regional and local agencies to allow use of their conveyance facilities. Also, Water Code Sections 386, 1702, 1706, 1727 and 1736 follow the common law and establish similar requirements for changes in water rights. Strictly speaking, economic issues are typically only required to be evaluated in water transfers that seek to utilize DWR's water conveyance facilities or those of other State or local agencies. However, economic impacts that are associated with physical changes to the environment may require analysis under the California Environmental Quality Act (CEQA).

interaction between the surface water and the groundwater that is affected by the additional pumping for the transfer. If there is interaction, then the extraction of groundwater is not truly an alternative source to the surface water supply and the net surface water flows will not increase as assumed.

This paper provides technical guidance to assist parties in developing the information necessary to support the assumption that the additional groundwater pumping for a groundwater substitution transfer does not affect the surface water system. This discussion is not a statement relative to the legal definition of groundwater for regulatory purposes, nor should it be used for that purpose. Currently, the regulatory distinction between surface water and percolating groundwater for water right permitting purposes does not rest on the connection between the two. Instead it is based on the establishment of the existence of "bed and banks." DWR does not wish to upset existing law as to the regulatory distinction between surface water and percolating groundwater. DWR's concern is that sufficient information be developed as part of the groundwater substitution proposal to support the assumption that surface water demands are in fact reduced by the like amount of additional groundwater pumping to support the transfer of the surface water.

Significant accretions and depletions in surface water flow due to groundwater flow occur along the Sacramento River. Normal groundwater pumping likely affects these flows and such effects are allowable under current California water law. However, if a party wishes to transfer surface water by virtue of the use of an alternative water supply, that party needs to establish that the supply is truly an alternative one to the surface water system during times of importance to downstream water users.

The technical guidance in this paper is presented by DWR to assist parties in avoiding injury to other legal users of water and harm to the environment in the development of groundwater substitution transfers.

II. Overview of Groundwater Substitution Transfers

A groundwater substitution transfer program is made up of several components: (1) the placement and characteristics of the wells that will be pumped, (2) the groundwater pumping program in terms of volume, schedule of the additional groundwater pumping, and the method of documenting and reporting the additional groundwater pumping, (3) the monitoring program to assess in real-time the effects of the groundwater substitution program on local groundwater users and surface water diverters, and (4) a mitigation program to be used to alleviate possible injury issues.

Parties are encouraged to provide to DWR staff early in the year (and substantially in advance of the dates noted in Section III.D), a description of the wells they may use in a groundwater substitution program. The description of the wells can be provided before the other details of the program are available. The wells will be evaluated using the factors presented in this paper. Approval of the wells by DWR early in the process will help expedite implementation of the overall program. DWR will coordinate this review with USBR.

The actual pumping program in terms of volume and schedule together with reporting, monitoring and mitigation elements of the program should be provided to DWR for review as soon as they are available. DWR will also coordinate the review of this information with USBR. Modifications to these programs may be recommended by DWR to help ensure injury does not occur through the implementation of the groundwater substitution program. The details of the groundwater substitution transfer program will be made part of the water purchase agreement with DWR.

If DWR is requested by a third party to move the water made available through groundwater substitution through DWR facilities, the concurrence of the program will be made part of the water conveyance agreement with DWR. DWR will assist in facilitating groundwater substitution transfer programs that meet the technical guidance outlined in this paper.

III. Evaluations of Wells and Well Placement

A. Need for the Evaluation of Wells

The groundwater and surface water systems in many areas of the Sacramento Valley are closely connected. The additional pumping for groundwater substitution transfers may reduce surface flows at some time in the future. A reduction of surface flows in a river, stream, canal, or drain that is tributary to the Sacramento-San Joaquin Delta (Delta) by a groundwater substitution transfer could injure DWR and USBR in their operation of the State Water Project (SWP) and Central Valley Project (CVP) respectively. The placement and construction of the wells to be used in a groundwater substitution transfer are a major factor affecting the potential of the water transfer to directly affect stream flows. All parties seeking the cooperation of DWR in a groundwater substitution transfer need to have the wells reviewed and approved by DWR for use in a groundwater substitution transfer prior to the initiation of the transfer. DWR will coordinate this review with USBR. This well use approval process is intended to reduce the likelihood of the groundwater substitution from directly affecting stream flows.

B. Status of Previously Accepted Wells

Wells approved for use in transfers in the early and mid-1990's will not be automatically approved based upon prior approval. Those previously approved wells were evaluated for drought emergencies or immediate water needs and required accelerated and limited reviews. Data were often incomplete and well locations were approximated. In addition, technical evaluation criteria for well placement and construction were not formulated until 1995. Therefore, those "previously approved wells" will have to undergo renewed data submittals and evaluations under the factors set forth in this document. This submittal of data for well approval also applies to many wells approved for the 2001 Forbearance Agreement due to the development of Figure 1, "Groundwater Substitution Water Transfers – Well Approval Areas." This figure adds significant new surface water features to those typically used in the past. The proximity of existing wells to these surface water features affects the criteria used

to evaluate the well's acceptability for inclusion in the groundwater substitution program.

Parties wishing to use wells that were used in previous transfers facilitated by DWR who do not have well logs or other information to support their continued use need to contact DWR at the earliest possible date. Additional monitoring to evaluate the effects of these wells on the surface water system may be substituted on a provisional basis to determine the acceptability of the continued use of these wells in the future.

This acceptability may reflect the degree to which water from these wells is affecting stream flows. If the data shows that some fraction of the water from these wells (for example, 30 percent) affects surface water flows, then credit for the water pumped could be adjusted to reflect this contribution (for example, credit for 7 of every 10 units of water pumped).

Wells approved under the technical guidance outlined in this paper will be acceptable under future transfers without any additional review unless local groundwater conditions degrade or threaten to degrade (e.g., the cause of overdraft, reduce water quality, or cause subsidence), or new geohydrologic studies change the understanding of the connection to the surface water system tributary to the Delta. If groundwater conditions have degraded, the use of the wells for future transfers will be reevaluated in light of the changes.

C. Wells Will be Evaluated Based Upon the Following Information:

1. The well's location relative to the surface features shown on the Figure 1. This figure is available in an Arcview georeferenced format to allow the expansion to any appropriate scale. To obtain the Arcview formatted copy of this map, contact Robert Niblack at Central District DWR at (916) 227-7540.

2. The well's surface annular seal, gravel pack interval and casing perforation depths.

3. The general permeability of geologic materials described on the well log.

4. Other information provided by the transferor, (e.g., well draw down tests, water quality and/or site-specific studies) that documents the well is not in hydrologic connection with surface waters tributary to the Delta.

5. Other information available to DWR or USBR. Parties proposing groundwater substitution transfers are encouraged to have proposed wells reviewed and pre-approved far in advance of the commencement of the proposed transfer. The wells could be reviewed while the overall groundwater substitution transfer is still being developed. This pre-approval of wells would help expedite the overall approval process.

D. Specific Information Needs Used to Evaluate Each Well

1. All wells involved in the groundwater substitution transfer, or proposed for use in future transfers, need to be identified (the name of the water district, name of the owner and the owner's well identification number) in a letter to DWR sent at least one month before the transfer is to begin.

2. A map showing the location of all wells that will be involved in the transfer needs to be submitted at least three weeks before the transfer is to begin. DWR or USBR may field verify the location of wells and their setup for use in the transfer (e.g., is groundwater to be applied to surrounding land, or is groundwater to be pumped into district canals, etc.).

3. Wells will be evaluated in part based on their proximity to major and minor surface water features tributary to the Delta potentially affected by groundwater pumping. Wells located further than two miles from major surface water features and further than one mile from minor surface water features will be automatically accepted without any additional information other than a map verifying the location of the well. However, the transferor should be aware of these wells' construction information when formulating the monitoring and mitigation programs.

4. Data for all wells involved in the groundwater substitution transfer located within two miles of a major surface water feature and within one mile of a minor surface water feature need to be provided within three weeks before the transfer begins. Well specific data acceptable to DWR consisting of the following need to be submitted:

    (a) A copy of a 7.5 minute quad sheet map showing the location of the well and the locations of nearby rivers, streams, canals or drains.

    (b) A driller's log giving the geology and well construction (well seals and well perforated intervals) or a letter from the drilling company giving this information. A geophysical log can be used in place of the geology on the driller's log. If the driller's log and the well construction are not matched (e.g., perforations opposite clay zones), additional information may be required.

    (c) In the absence of the data in item (b), any other information (groundwater quality, pumping tests, localized studies) that will show the well is not hydrologically connected to a nearby river, stream, canal or drain.

5. Wells located near **major** surface water features[4] tributary to the Delta potentially affected by groundwater pumping shown in Figure 1 will be evaluated by using the following procedure:

    (a) Wells located between one and two miles of a major surface water feature tributary to the Delta will be accepted unless one of the following applies:

[4] Major surface water features tributary to the Delta affected by groundwater pumping are: Sacramento River, Feather River, Big Chico Creek, Cottonwood Creek, Stony Creek, Yuba River, including the Yuba Gold Fields, American River and the Cosumnes River.

(1) No driller's log or other sufficient information is submitted to demonstrate that the well is not connected to the surface water system tributary to the Delta, or

(2) The well is perforated above 50 feet and insufficient information is submitted to demonstrate that the well is not connected to the surface water system tributary to the Delta.

(b) Wells located within one mile or less from a major surface water feature tributary to the Delta will be accepted if the following conditions are met:

(1) The uppermost perforations start below 150 feet, or:

(2) The uppermost perforations start between 100 and 150 feet and:
There is a surface annular seal to at least 20 feet; and
There is a total of at least 50-percent fine-grained materials in the interval above 100 feet; and

There is at least one fine-grained layer that exceeds 40 feet in thickness in the interval above 100 feet; or

(3) Other information is provided to DWR and USBR that demonstrates that the well is not in connection with the surface water system tributary to the Delta.

6. Wells located near **minor** surface water features[5] tributary to the Delta potentially affected by groundwater pumping will be evaluated by using the following procedure:

   (a) Wells located between one half and one mile of minor surface water features tributary to the Delta will be accepted using the same criteria listed for 5(a) above.

   (b) Wells located within one-half mile or less from a minor surface water feature tributary to the Delta will be approved using the using the same criteria listed for 5(b) above.

7. Groundwater substitution transfers involving wells in the following areas will also be evaluated to determine each well's possible negative impact upon the local groundwater regime:

   (a) Wells in areas of long-term groundwater overdraft (as evidenced by long-term groundwater level declines),

   (b) Wells in areas of past ground subsidence or,

   (c) Wells in areas adjacent to poor groundwater quality.

IV. Evaluation of the Groundwater Substitution Program

Once the wells have been reviewed and approved by DWR and USBR, the overall groundwater substitution transfer program needs to be developed by the water transfers proponent and provided to DWR. The program includes: (1) the wells that will be pumped, (2) the schedule and volume of water to be pumped, (3) the baseline from which the additional pumping will be measured, (4) the method of measuring and reporting the volume of water pumped, (5) a

[5] Minor surface water features tributary to the Delta potentially affected by groundwater pumping and shown on Figure 1 are: Colusa Basin Drain, Tule/Toe Canal, and Natomas Cross Canal.

monitoring program and (6) a mitigation program. The details of the groundwater substitution program will be among the contractual commitments in the water purchase or water conveyance agreement with DWR.

Compliance with local requirements (including ordinances relating to well drilling and groundwater extraction) and local groundwater management plans, as well as compliance with adjudications and with the overdraft protections in Water Code Section 1745 *et seq*.,[6] will be the responsibility of the entity proposing the groundwater substitution transfer.

V. Monitoring Program

A good monitoring program is an essential component of a successful groundwater substitution transfer program. Such a monitoring effort will document whether the additional pumping due to the groundwater substitution transfer is affecting adjacent wells or downstream users and the magnitude of this effect. Monitoring also provides those conducting the groundwater substitution program information to address fears and claims of alleged injury. More importantly, the monitoring program provides information to allow quick action to address and mitigate legitimate claims of injury before they become severe.

The costs of the monitoring and mitigation programs need to be included in the overall operations and maintenance costs of a groundwater substitution program. An appropriate share of the operation and maintenance costs of the program are expected to be passed on to those purchasing the water supply.

The groundwater substitution transfer proponents need to prepare a Monitoring Program and provide it to DWR at least six weeks prior to project pumping. The Monitoring Program needs to incorporate the use of a selected number of groundwater wells used for pumping and other wells as

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[6] California Water Code Section 1745.10 requires groundwater substitution transfers to be either (1) consistent with a groundwater management plan adopted pursuant to state law for the affected area or (2) approved by the water supplier from whose service area the water is to be transferred and that water supplier, if a groundwater management plan has not been adopted, determines that the transfer will not create, or contribute to, conditions of long-term overdraft in the affected groundwater basin.

appropriate. These wells, collectively called Monitoring Program Wells, will be monitored for water levels, water quality, and well discharge rates and volumes. The number of Monitoring Program Wells in the Monitoring Program will be based on their ability to accurately represent groundwater levels and response in the region before, during, and after transfer pumping takes place. Locations of proposed Monitoring Program Wells to be included in the proposed Monitoring Program will be plotted on USGS 7.5-minute quadrangle maps and will be listed in a table showing well owner, well name or owner's number, State Well Number, and latitude and longitude (handheld GPS).

A. Monitoring Wells

Monitoring Program Wells need to be configured with a permanent instantaneous and totalizing flow meter, access for measuring water levels, and be free of lubricating oil in the well casing or water level sounding tube.

B. Purpose of the Monitoring Program

The Monitoring Program needs to describe how the monitoring data will be collected reported and evaluated in order to:

1. Quantify and verify the groundwater portion of the transfer agreement.

2. Determine direct and residual effects of transfer pumping on the groundwater basins.

3. Assess the occurrence of any third party impacts and, if they occur, their magnitude and significance.

4. Determine the surface water/groundwater interactions in the areas where groundwater is pumped for the transfer agreement, including both pumping-induced infiltration and interception of groundwater discharge, or identify a program that addresses this issue[7].

[7] The monitoring program needs to provide information on the interaction of the groundwater and surface water system. Parties are encouraged to pool resources and seek additional resources to conduct a more comprehensive

C. Scope and Monitoring Program Coordination with Other Efforts.

The network of monitored wells needs to be sufficient to allow the evaluation of the local, regional and downstream effects of groundwater substitution transfers. The network will allow this evaluation for both areas within and areas adjacent to the well field, and allow differentiation of effects from other local and regional groundwater conditions. Similarly, the network needs to be such that potential third-party impacts can be identified and differentiated from seasonal or other water level changes in the basin.

Groundwater substitution transfer proponents are encouraged to investigate ongoing monitoring that is being conducted in their area by DWR (or other agencies), and to integrate their proposed monitoring network into these ongoing monitoring efforts. Cooperative and integrated groundwater monitoring efforts benefit the groundwater substitution proponents by:
(1) helping to reduce overall costs, (2) helping to obtain access to wells and information that may be difficult to do on their own, and (3) taking advantage of DWR District Staff's knowledge and expertise in turning groundwater data into unbiased information to assist in decision making.

D. Monitoring Program Contact

The proposed Monitoring Program should identify a contact person who will conduct the monitoring and assemble the data for submission to DWR. The contact person will meet with DWR's representative at least two weeks before the start of the groundwater pumping. Together, these parties may visit the Monitoring Program Well sites prior to the start of pumping to measure pre-pumping groundwater levels and read and inspect flow meters. DWR will coordinate this review with USBR staff.

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evaluation of these interactions due to water transfers. Such a program is contemplated as part of the Sacramento Valley Water Management Agreement discussions. If such a program is developed, it may be used by parties to address these issues provided the specific water transfer proposal is incorporated in the study and the water transfer proponent participates in the study.

E. Monitoring Program Elements

The minimum Monitoring Program elements need to include the following activities:

1. Instantaneous and total flow, monthly and at the end of transfer pumping from every well pumped for the groundwater substitution program.

2. Measurement of water levels in Monitoring Program Wells:

   (a) Not more than two weeks prior to the start of transfer pumping.

   (b) Every second day during the first 14 days of transfer pumping.

   (c) Weekly during the third through the last week of transfer pumping.

   (d) Every other week after pumping stops and until water levels recover to pre-pumping conditions or water levels stabilize.

3. Field measurement of electrical conductivity in all Monitoring Program Wells during every water level monitoring visit while the well is pumping.

F. Evaluation and Reporting

The proposed monitoring program needs to describe the method of reporting which, at a minimum, will include providing of data summary tables to DWR (and as appropriate USBR) each month during pumping under the program until the groundwater levels return to those prior to the start of the pumping. The program needs to also include a summary report on the quantity pumped, the impact on groundwater and surface water during and after pumping, and the extent and significance, if any, of impacts to local groundwater users.

VI. Mitigation Program

The effects of the additional groundwater pumping for a groundwater substitution transfer on adjacent groundwater users are difficult to know with certainty in advance. The monitoring program will identify areas that may become affected by the additional pumping. An effective mitigation program is needed to verify and correct problems that arise due to this additional pumping related to the groundwater substitution transfer. If these possible effects go uncorrected, the transfer of the surface water together with the additional groundwater pumping to support the transfer could cause injury to legal users of the groundwater and harm the environment. DWR will not participate in a water transfer that does not include an adequate mitigation program as part of the overall groundwater substitution program. Therefore, the local party conducting the groundwater substitution transfer needs to include as part of the transfer, a mitigation program that effectively corrects possible injury before it becomes critical. A mitigation program might include:
(1) curtailment of pumping until natural recharge corrects the issue, (2) lowering of pumping bowls in wells, (3) reimbursement for significant increases in pumping costs due to the additional groundwater pumping to support the transfer, and (4) other action as appropriate.

Groundwater pumping to support water transfers is very controversial in many Northern California counties. Groundwater substitution transfer proponents need to quickly and aggressively mitigate impacts caused by groundwater substitution transfers in the local area if these transfers are to be useful in the future. DWR is committed to promoting responsible groundwater substitution transfers that protect the water users and the environment in the water source areas.

VII. Protection of Water Rights

California law protects the underlying water rights of those parties who wish to transfer a portion of their surface water supply to others. Water Code Section 1011.5 specifically protects the surface water rights of water users who use groundwater in lieu of surface water rights. However, reporting requirements apply. Water Code Section 1745 *et seq*., also protects the underlying water rights from forfeiture for water transfers to the State's Dry Year Water Purchase Program and other programs. In addition, DWR's

water purchase agreements expressly recognize the legal protections afforded the seller's underlying water rights. Additional information about water rights protection and water transfers is available in the "Guide to Water Transfers" published by SWRCB staff and available on SWRCB web site at www.waterrights.ca.gov.

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